NASA/TM-2003

SIMBIOS Project 2003 Annual Report

Giulietta S. Fargion, Science Applications International Corporation, Maryland
Charles R. McClain, Goddard Space Flight Center, Greenbelt, Maryland

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

December 2003

Chapter 19

Assessment, Validation, and Refinement of the Atmospheric Correction Algorithm for the Ocean Color Sensors

Menghua Wang

University of Maryland, Baltimore County, Baltimore, Maryland

19.1 INTRODUCTION

The primary focus of this proposed research is for the *atmospheric correction algorithm evaluation and development* and *satellite sensor calibration and characterization*. It is well known that the atmospheric correction, which removes more than 90% of sensor-measured signals contributed from atmosphere in the visible, is the key procedure in the ocean color remote sensing (Gordon and Wang, 1994). The accuracy and effectiveness of the atmospheric correction directly affect the remotely retrieved ocean bio-optical products. On the other hand, for ocean color remote sensing, in order to obtain the required accuracy in the derived water-leaving signals from satellite measurements, an on-orbit vicarious calibration of the whole system, i.e., sensor and algorithms, is necessary. In addition, it is important to address issues of (i) cross-calibration of two or more sensors and (ii) in-orbit vicarious calibration of the sensor-atmosphere system. The goal of these researches is to develop methods for meaningful comparison and possible merging of data products from multiple ocean color missions. In the past year, much efforts have been on (a) understanding and correcting the artifacts appeared in the SeaWiFS-derived ocean and atmospheric produces; (b) developing an efficient method in generating the SeaWiFS aerosol lookup tables, (c) evaluating the effects of calibration error in the near-infrared (NIR) band to the atmospheric correction of the ocean color remote sensors, (d) comparing the aerosol correction algorithm using the single-scattering epsilon (the current SeaWiFS algorithm) vs. the multiple-scattering epsilon method, and (e) continuing on activities for the International Ocean-Color Coordinating Group (IOCCG) atmospheric correction working group. In this report, I will briefly present and discuss these and some other research activities.

19.2. RESEARCH ACTIVITIES AND RESULTS

Earth Curvature Effects Measured by SeaWiFS

This work has been described in an article by Wang (2003). It is a common fact that the Earth's atmosphere is a spherical-shell atmosphere (SSA) rather than a plane-parallel atmosphere (PPA). Thus, the light scattered by the Earth's atmosphere is governed by physics of the radiative transfer equation (RTE) with proper boundary conditions in the SSA system. In the satellite and aircraft remote sensing, however, the PPA model is usually assumed to compute the lookup tables and convert the sensor-measured signals to the desired physical and optical quantities. The PPA assumption is a simple yet very good approximation for solar and sensor zenith angles $< \sim 80°$. Note that the solar and sensor zenith angles in here are defined as a measure at the local surface. In the PPA assumption, however, the solar zenith angles $\geq 90°$ is not defined. When the solar zenith angles $\geq 90°$ in the PPA system, i.e., when the sun is below the horizon, there will be no light scattered out to the top of the atmosphere (TOA) or at the bottom of the surface. We would experience completely darkness in this situation. The ocean color satellite sensor Sea-viewing Wide Field-of-view Sensor (SeaWiFS) acquired imageries with the solar zenith angles $\geq 90°$ and provided good examples of the Earth's curvature effects on the light scattering processing in the SSA system.